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1 **Investigating the impact of virtual tourism on travel intention during the post-COVID-19 era:**  
2 **Evidence from China**

3  
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12  
13 **Abstract:**

14 This study explores the mechanism that contributes to travel intention in the field of virtual tourism. The  
15 overall research method is based on the "Stimulus-Organism-Response" (SOR) theory. In the research model,  
16 the effects of content quality, system quality, and interaction quality in virtual tourism on tourism experience  
17 and travel intention are explored, as well as the role of virtual attachment and travel intention. A total of 390  
18 respondents were invited to participate in a virtual tourism experience before providing feedback through a  
19 questionnaire. SmartPLS 3.3.2 was used to validate the causal model, and most of the study hypotheses were  
20 supported. The findings show that virtual tourism significantly promotes travel intention. Specifically,  
21 content quality, system quality, and interaction quality positively affect tourists' travel intention through the  
22 complementary mediations of tourism experience and virtual attachment; and system quality even directly  
23 promotes travel intention. However, tourism experience does not affect virtual attachment. The present study  
24 extends prior studies on virtual tourism with SOR as a general model for field tourism experience research,  
25 while demonstrating the effectiveness of virtual tourism in promoting tourists' travel intention. The results  
26 are useful in assisting governments in developing relevant policies and services, as well as helping tourism  
27 companies understand virtual tourism as an enhancement for tourist travel intention, thus contributing to the  
28 recovery of the tourism industry in the post-COVID-19 era.

29 **Keywords:** Virtual tourism, stimulus-organism-response model, travel intention, PLS-SEM, post-COVID-  
30 19, China

31 **Paper type:** Long research paper

32  
33 **1. Introduction**

34  
35 The COVID-19 pandemic was the most significant public health emergency with the most rapid spread and  
36 broadest infection range since the founding of the People's Republic of China in 1949 (Zhang, 2020). During  
37 the outbreak, economic activities in China were basically at a standstill (Qarnain et al., 2020), except for  
38 certain industries that still functioned to meet the basic needs of the public. The outbreak significantly  
39 disrupted the entire tourism industry due to the allopatric and clustered nature of tourism activities (XIE &  
40 SHA, 2012), a series of activities undertaken by tourists who travel from the source to the destination via the  
41 tourism corridor. In response to COVID-19, Chinese cities have primarily closed communities, surrounding  
42 villages, and towns to restrict the movement of people. As a result of this response, demand for tourism  
43 activities was passively reduced to zero. Travel agencies, which were the gateways, were asked to suspend  
44 their operations. In contrast, air carriers and railroads, as the gateways, changed their usual "change and

45 refund" policy and offered refunds to passengers who had already purchased tickets. Accordingly, passenger  
46 traffic and revenue in the transportation industry plummeted during the pandemic (Suau-Sanchez et al., 2020).  
47 In tourist destinations, tourist attractions were almost completely shut down. Hotels were either shut down,  
48 or provided temporary housing for medical staff or used as temporary isolation sites to receive patients (Chen  
49 et al., 2020). Arguably, the tourism supply was essentially at zero.

50 The sudden onslaught of COVID-19 kept people at home (Altena et al., 2020), which was a big blow to  
51 the offline tourism industry. Since the pandemic was alleviated in China, the offline tourism industry still  
52 faces a significant challenge (Donthu & Gustafsson, 2020). In this course, the tourism industry has also  
53 explored new ways of development, i.e., "virtual tourism (Zhang et al., 2022)", "live-streaming tourism (Qiu  
54 et al., 2021)", and other new ways of relaunching the tourism industry with the help of the internet and  
55 innovative technologies. The segmentation of "smart technology + tourism" is reflected in integrating virtual  
56 reality (VR) technology and tourism products (Loureiro et al., 2020). The development of virtual reality  
57 technology has broken through past limitations, which could only simulate the natural environment through  
58 pictures or videos and provided participants with a better "immersion" experience (Hudson et al., 2019). As  
59 the influence of VR technology expands and attracts more attention, relevant academic research also becomes  
60 increasingly available. Pioneering research mainly combines virtual reality technology with landscape design,  
61 medical education, and disease treatment from the research content. Nevertheless, further literature search  
62 revealed that the existing literature on "VR and tourism" is sparse. Scholars have now focused on the  
63 marketing value of VR technology (Leung et al., 2020; Lo & Cheng, 2020; Song et al., 2020) and destination  
64 image building (Alyahya & McLean, 2021; Chang, 2021; Lin et al., 2020). Although the methods used in  
65 these studies are relatively homogeneous and lacking in empirical evidence, they still provide vital tools,  
66 methods, and mindsets for studying VR technology and tourism. The theory has guiding significance for  
67 practice, and VR technology, as a new communication medium, has an immeasurable impact on the tourism  
68 industry's development. Hence, it is imperative to strengthen academic research in virtual tourism.

69 The decisive intervention of virtual technology has given new connotations, characteristics, and forms to  
70 the relationship between people and places (El-Said & Aziz, 2021). The traditional binary space of tourist  
71 and physical tourist places shifts into the ternary connections between virtual place, tourist, and real place.  
72 The interrelationship of such ternary spatial continuity has become an essential topic in the study of the  
73 people and the place in the digital era. At present, scholars have paid attention to constructing the ternary  
74 space (Kunz & Seshadri, 2015). However, the study of tourists' behavioral intentions in the ternary space still  
75 needs to be advanced. Virtual tourism may affect users' experiences, attitudes, and behaviors (Chung et al.,  
76 2015; Jung et al., 2015; Tussyadiah et al., 2018). However, the way virtual tourism affects users' travel  
77 experience and emotional attachment, as well as the role of virtual tourism on future travel intention *in the*  
78 *field*, is still unclear. Therefore, starting from the SOR theory, this paper constructs a model of the influencing  
79 factors of virtual tourism experience (3D reconstruction of the real tourism place) - the inner psychology of  
80 users in the virtual tourism process - the travel intention in the field. We explore how virtual tourism uses  
81 digital technology to construct users' attachment to real tourism places and then influence their travel  
82 intention in the field.

83 This study, therefore, starts from the characteristics of virtual tourism, draws on the research theories and  
84 experiences of established social media platforms such as live streaming, short video, and online shopping,  
85 while introducing two mediating variables of tourism experience and virtual attachment based on the  
86 psychological perspective, with the "Stimulus-Organism-Response" theory (referred to as SOR model) as the  
87 theoretical framework. We construct a conceptual model of the impact of virtual tourism on tourists' travel  
88 intention, and carry out empirical analysis to explore how virtual tourism affects field travel intention through

89 users' intrinsic state. This study contributes to a comprehensive and in-depth understanding of the new  
90 tourism human-ground relationship in the information age. It clarifies the mechanism of human-ground  
91 emotional attachment in virtual tourism, as well as the mechanism of virtual tourism influence on users' travel  
92 intention in the field, deepening the study of the human-place relationship in the ternary space. The results  
93 provide a feasible direction for promoting the integration of tourism locations and people in the information  
94 age. Furthermore, this study has important practical implications for the experience design of virtual tourism,  
95 tourism destination marketing innovation, and enhancement of tourist loyalty in the post-COVID-19 era.  
96 Overall, this paper empirically examines the impact of virtual tourism on tourists' travel intention in the field  
97 through the questionnaire method, specifically by addressing the following research questions:

98 RQ1: Does the virtual tourism experience increase users' travel intention in the field?

99 RQ2: What factors contribute to tourists' travel intention in the field of virtual tourism?

100 RQ3: How do important influencing factors of virtual tourism experience (content quality, system quality,  
101 interaction quality), tourism experience, virtual attachment, and travel intention interact with each other?

## 102 103 **2. Theoretical background and research hypothesis**

### 104 105 **2.1 Stimulus-Organism-Response (SOR) model**

106 The Stimulus-Organism-Response (SOR) model is a model of human cognitive behavior, first proposed by  
107 (Mehrabian & Russell, 1974). It reflects the "stimulus-perception-response" process of human behavior. The  
108 SOR theory model suggests that stimuli from the external environment influence individuals' behavioral  
109 decisions by affecting their emotions. The term "stimulus" refers to the factors that stimulate and cause  
110 individuals to act (Sherman et al., 1997). The term "organism" refers to an individual's interior psychological  
111 state (Sherman et al., 1997). The term "response" refers to the individual's numerous behaviors or behavior  
112 intentions in response to the stimuli and the organism (Sherman et al., 1997). In the SOR framework, the  
113 stimulus is generally used as the independent variable, the organism as the mediating variable, and the  
114 response as the dependent variable. SOR began as a cognitive model used in psychology and is now  
115 frequently utilized to examine Internet user behavior (Chen & Yao, 2018; Kim et al., 2018; Ul Islam &  
116 Rahman, 2017; Zhu et al., 2020).

117 In tourism research, the SOR model was used to study travel experience (Chen et al., 2021; Min et al.,  
118 2019), travel intention (Min et al., 2019; Su et al., 2021; Turulja & Činjarević, 2021), and user engagement  
119 (Ali et al., 2021; Tian et al., 2021; Yadav et al., 2021). Researchers have found various factors capable of  
120 influencing tourist travel intention, including tourists' internal reasoning and the influence of certain external  
121 factors, such as tourists' reference information, personal perceptions, and perceived risks (Mullet & Karson,  
122 2018). Various social, economic, and psychological factors may impact tourists' travel intentions. Among  
123 them, both the reference group and the individual's subjective perceptions play a vital role in forming travel  
124 intentions. The reference group of tourists and their subjective knowledge psychologically form emotional  
125 preferences and inherent impressions of a tourist destination, which affects the willingness and choice of  
126 tourists to travel to that destination. SOR theory suggests that the external environment stimulates the  
127 individual's perceptions and emotions, which affects the individual's behavior (Song et al., 2021). Therefore,  
128 in studies of consumer travel intentions or behaviors, giving subjects "S" (e.g., VR environment) stimuli  
129 before measuring "R" (e.g., questionnaire results) tend to reveal more valid findings when travelers use  
130 digital technology such as virtual reality (VR), artificial intelligence (AI), and augmented reality (AR) to  
131 immerse themselves in a highly immersive virtual tourism experience. The process of content stimulation  
132 produces the individual's organism, i.e., psychological state. The content quality, system quality, and

133 interaction quality of virtual tourism will directly impact the tourists' tourism experience and virtual  
134 attachment, which will affect the tourists' travel intention in the field.

135

## 136 **2.2 The impact of virtual tourism experience on tourists' intrinsic state**

137 According to previous research findings, content quality, system quality, and interaction quality are essential  
138 variables that entice tourists to use digital devices for virtual tourism experiences (Jung et al., 2015; Moon &  
139 Han, 2018b; Styliadis et al., 2021). According to the SOR theory, tourists experienced content quality, system  
140 quality, and interaction quality of the virtual travel as stimuli in the experience process. The organism, i.e.,  
141 the internal process that mediates the external stimulus and behavioral response received by the individual,  
142 is in this study expressed as the tourist experience and virtual attachment of tourists.

143

## 144 **2.3 Virtual tourism and tourism experience**

145 Experience is an objectively existing psychological need. Essentially, the tourism experience is an  
146 individualized feeling of an individual responding to certain stimuli (Packer & Ballantyne, 2016). Morrison  
147 et al. discovered that physical environmental factors such as music, lighting, and facilities were positively  
148 associated with customer mood (Morrison et al., 2011). Lee, park, and Han found that the quality of online  
149 content affects user engagement and acceptance. Due to the attractiveness of the web, uploading high-quality  
150 images or videos can influence user satisfaction (Lee et al., 2014). Ghose and Huang found that the higher  
151 the availability of modern technology, the more companies can promote product quality through personalized  
152 services and products. In this way, service quality is improved by increasing satisfaction (Ghose & Huang,  
153 2009). In the context of virtual tourism, its interaction quality mainly refers to the ability to provide  
154 personalized information, understand tourists' needs and preferences, and personalized interactions. Chang  
155 designed an AR-based cultural heritage tour system. He found through a questionnaire that tourists had a  
156 strong experience with this system (Chang et al., 2015). Jung's study found that the content of augmented  
157 reality technology, personalized services, and system quality affect tourists' experience and thus their  
158 satisfaction (Jung et al., 2015). Based on this, this study proposes the following hypotheses:

159 H1: The content quality of virtual tourism positively affects the tourism experience;

160 H2: The system quality of virtual tourism positively affects the tourism experience;

161 H3: The interaction quality of virtual tourism positively affects the tourism experience.

162

## 163 **2.4 Virtual tourism and virtual attachment**

164 The specific and deep connections people make to a place by assigning meaning to it are called "place  
165 attachments" (Oleksy & Wnuk, 2017). Attachment refers to "the human tendency to develop strong emotional  
166 ties to specific people and objects (Bowlby, 1977)". With the development of technology, an individual's  
167 attachment is not necessarily to a real place. However, it can be extended to a broader scope (Rakić &  
168 Chambers, 2012). For example, with the rapid development of new media, people with common interests or  
169 experiences communicate and interact through computer networks, creating emotional attachments to the  
170 virtual communities they form (Chan & Li, 2010). When experiencing social isolation or loneliness, some  
171 users develop an emotional attachment to the Internet and social media (Wang et al., 2021).

172 Moreover, in the context of the current COVID-19 pandemic, virtual tourism rekindles tourists' travel  
173 confidence, helps them gain a sense of control and security, and regains their travel rhythm. Attachment arises  
174 from experience (Gross & Brown, 2008; Io & Wan, 2017), and the perceived value of different experiences  
175 has different effects on attachment production (Frost et al., 1995; Pelled & Hill, 1997). When the virtual  
176 world is more realistic, the user's visual senses are more actively involved in aesthetic perception, resulting

177 in a more memorable experience and encouraging attachment to virtual tourism (Kim et al., 2018). In addition,  
178 the dual stimulation of content quality (virtual scenery) and interactive format (virtual experience) allows  
179 users to perceive the experience value of entertainment and enjoyment (Oleksy & Wnuk, 2017). When users'  
180 own emotional needs are satisfied, they will have a positive emotional evaluation of the virtual scenery, which  
181 leads to the enhancement of virtual attachment (Oleksy & Wnuk, 2017). This study contends that while  
182 utilizing digital devices for virtual tourism, tourists perceived positive content quality, system quality, and  
183 interaction quality would drive their connection to virtual tourism. Therefore, the following hypotheses are  
184 proposed in the present study:

185 H4: The content quality of virtual tourism positively affects virtual attachment;

186 H5: The system quality of virtual tourism positively affects virtual attachment;

187 H6: The interaction quality of virtual tourism positively affects virtual attachment.

188

## 189 **2.5 The impact of tourists' intrinsic state on travel intention**

190

### 191 *2.5.1 Tourism experience and travel intention*

192 The organism is an internal cognitive process in response to external stimuli. In this process, the information  
193 generated by the organism as a result of the stimulus, such as sensations, perceptions, and emotions, will  
194 become the basis for subsequent travel intentions and travel behaviors. The emotions generated by an  
195 individual stimulated by the external environment will lead the user to approach or avoid behaviors towards  
196 the environment and mediate between environment and behavior (Yüksel, 2007). Ekanayake found that  
197 tourists' experiences positively influenced their travel intentions by studying tourists in the eastern province  
198 of Sri Lanka (Ekanayake & Gnanapala, 2016). Kim studied tourists of virtual reality tourism based on the  
199 diffusion of innovation theory. He found that users' authentic tourism experience positively affects their travel  
200 intention (Kim et al., 2020). Kim and Jung studied the effect of tourists' authentic experience on their travel  
201 intention based on SOR theory. The study finds that tourists' behavioral intentions are influenced by their  
202 sense of authentic virtual reality tourism experiences (Kim et al., 2018). Raouf Ahmad Rather investigated  
203 the impact of experiential marketing activities on tourists' behavioral intentions in tourist destinations. It was  
204 found that tourists' experiences of marketing activities in tourist destinations affect their travel intention  
205 (Rather, 2019). Based on this, this paper proposes the following hypothesis:

206 H7: Tourism experience positively affects travel intention.

207

### 208 *2.5.2 Virtual attachment and travel intention*

209 The prior studies have found that with the intervention of network information, the traditional two-  
210 dimensional perspective of the human-territory relationship is extended to a three-dimensional space. New  
211 human-territory links and interaction forms of (real)person-(virtual)person, (virtual)person-(virtual)place,  
212 and (real)place-(virtual)place emerge (Chen & Zhenfang, 2020). The cognition, emotion, and behavior of  
213 virtual and real spaces influence each other and intermingle. Users' purchase intentions in the virtual world  
214 are consistent with those in the real world (Suh et al., 2011), and Ren et al. demonstrated that attachment to  
215 virtual communities affects the frequency with which individuals visit virtual communities (Ren et al., 2012).  
216 Kim et al. also found that their attachment to VR influenced VR tourism users' intentions to visit real places  
217 (Kim et al., 2018). Therefore, based on the above literature, this study argues that users' awareness and  
218 behavior in the virtual world somehow represent real-world awareness and behavior. Virtual attachment  
219 enhances tourists' desire for real-world travel destinations. Therefore, the virtual attachment will stimulate  
220 the travel intention in the field. Based on this, the following hypothesis is proposed:

221 H8: Virtual attachment positively affects travel intention.

222

### 223 2.5.3 *Virtual attachment and tourism experience*

224 Regarding the relationship between residents' activity participation and local attachment, many empirical  
225 studies point out that residents' involvement in local activities positively affects their local attachment (Guest  
226 & Lee, 2016; Rollero & De Piccoli, 2010; St. John et al., 1986). Furthermore, through an empirical study,  
227 Kyle et al. and Hwang et al. found that tourists' leisure activity participation had a significant positive effect  
228 on their place attachment (Hwang et al., 2005; Kyle et al., 2017). In the study on the relationship between  
229 the cognitive gap, affective experience, and place attachment, scholars also confirmed that affective  
230 experience positively affects place attachment (Hidalgo & HernÁNdez, 2001). The higher the quality of  
231 tourists' emotional experience, the higher their level of attachment. It is hypothesized that the higher the  
232 positive tourism experience, the greater the likelihood that the tourist will develop a virtual attachment to the  
233 destination. Based on this, the following hypothesis was proposed:

234 H9: Tourism experiences positively influence virtual attachment.

235

### 236 2.5.4 *The mediating role of the tourists' intrinsic state*

237 The SOR theory emphasizes the mediating role of the response between the stimulus and the individual's  
238 behavior. By comparing the results of prior studies, it was found that tourism experience and virtual  
239 attachment play a connecting role between various influencing factors and behavioral intention. Chae, Kuo  
240 et al. found that service quality positively impacts customer recommendation and continued usage behavior  
241 (Chae et al., 2002; Kuo et al., 2009). Wang and Chen found that the presentation of information systems  
242 positively affected consumers' intention to use them (Wang & Chen, 2011). Jung points out that the quality of  
243 content affects tourists' attitudes toward AR applications (Jung et al., 2016). N Zhang et al. found that brand  
244 attachment exerts a partial mediating effect on the relationship between effective CC and brand commitment  
245 (Zhang et al., 2013). Jenny Lee et al. found a mediating effect between place attachment on satisfaction and  
246 loyalty (Lee et al., 2012). Based on this, the following hypotheses were formulated:

247 H10: Tourism experience has a mediating role in influencing travel intention on content quality;

248 H11: Tourism experience has a mediating role in influencing travel intention on system quality;

249 H12: Tourism experience has a mediating role in influencing travel intention on interaction quality;

250 H13: Virtual attachment has a mediating role in influencing travel intention on content quality;

251 H14: Virtual attachment has a mediating role in influencing travel intention on system quality;

252 H15: Virtual attachment has a mediating role in influencing travel intention on interaction quality.

253

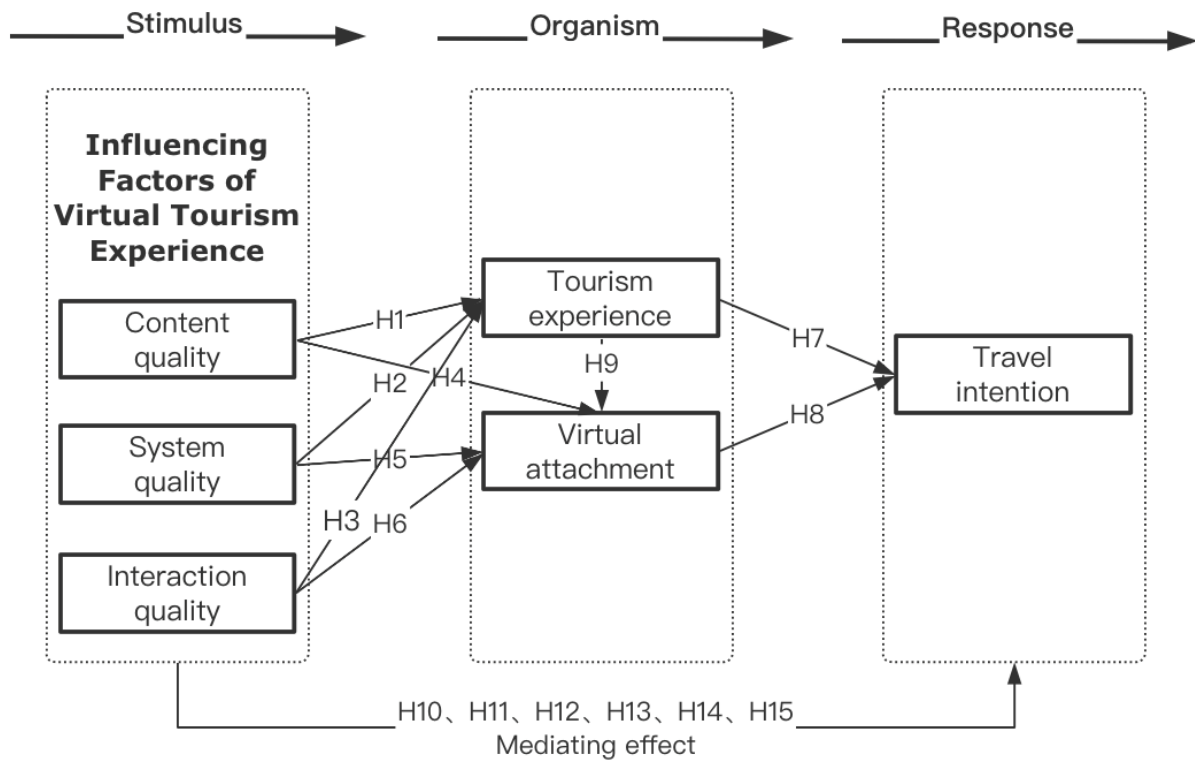
## 254 **3. Methods**

255

### 256 **3.1 Research model**

257 In summary, this study employs SOR theory as the research framework. Content quality, system quality,  
258 and interaction quality of virtual tourism as the antecedent variables of tourism experience, virtual attachment,  
259 and tourists' travel intention in the field. The construction of a research model of the factors influencing  
260 virtual tourism on tourists' travel intention in the field, as shown in Figure 1.

261



262

263 Figure 1. Research model

264

265 **3.2 Usability test design and data collection**

266 Virtual tourism is a new type of tourism as well as a new industry. Currently, Chinese tourists have less  
 267 exposure and knowledge about it (Lu et al., 2021; Wu, 2020). With universal access to such new consumer  
 268 technology, we implemented a real usage scenario to get participants actually and bodily experience virtual  
 269 tourism in the field. The few users who already experience virtual tourism products were not directly selected  
 270 for this study. In this way, researchers can measure users' temporal-sensitive experience and concurrent travel  
 271 intention after the tourists have touched and used the virtual tourism device. The specific method can be  
 272 referred to as "usability testing (Dumas et al., 1999)". The concept of usability testing was first introduced in  
 273 1981 (Krahmer, 2004). Usability testing evaluates the usability and unavailability of a product based on  
 274 certain usability criteria. Usability testing is also a programmed process used to identify problems that may  
 275 occur during user-product interaction. In a narrow sense, Usability testing refers to user testing methods that  
 276 allow a representative group of users to perform typical operations on a product. At the same time, observers  
 277 and design developers observe, listen, and record. It is a process used to evaluate a product or system's  
 278 external form, functional operation, and interaction patterns (Dumas et al., 1999).

279 Previous studies investigated the research and application of usability tests from multiple aspects and  
 280 dimensions in tourism research. Researchers discuss usability test methods and applications from different  
 281 perspectives, including usability evaluation methods such as user testing (Othman et al., 2021), questionnaire  
 282 survey (Pratidina & Setyohadi, 2021), and eye-tracking technology (Font et al., 2021). And the researchers  
 283 also make practical exploration of usability test research. We can consider usability tests an effective  
 284 verification method for analyzing user behavior and experience. This lays an important theoretical foundation  
 285 for this study.

286

287 **3.3 Participants**



288 Our research team obtained the research sample (Table I) in two ways: First, we recruited virtual tourism  
 289 experience participants (52% of the total number) through the online social media platform Sina Weibo. With  
 290 over 300 million monthly active users, Sina Weibo is the largest public social media platform in China. The  
 291 researcher recruited participants by posting recruitment posts on the Sina Weibo platform. The research team  
 292 then used the Weibo targeted promotion service to promote the recruitment posts to users who were  
 293 potentially willing to participate in the virtual tourism experience. Second, the research team recruited users  
 294 who were willing to participate in virtual tourism through offline in-person networks (48% of the total  
 295 population). In the data collected, we found that the number of users aged 18-25 who had experienced virtual  
 296 travel was higher than those in other age groups. This is consistent with Li & Chen's (2019) findings.  
 297 Therefore, we believe that the research sample obtained is highly credible, reliable, and reproducible in terms  
 298 of feedback effects. Our research team was trained to strictly follow the test procedures to ensure data quality.  
 299 The participants were also asked to follow the test procedures strictly.

300 SPSS 25.0 was used to perform descriptive statistical analysis on the sample data to investigate the  
 301 sample's demographic characteristics, as shown in Table 1. A total of 390 subjects were recruited to  
 302 participate in the virtual tourism experience, of which 53.6% and 46.4% were male and female, respectively.  
 303 In terms of age, users aged 18-25 account for the most significant proportion, 33.8 percent, followed by users  
 304 younger than 18, accounting for 25.1 percent; in terms of education, bachelor's education is the mainstay,  
 305 accounting for 64.6 percent.

307 Table 1. Distribution of participants (N = 390).

Measure	Category	Frequency	Percentage (%)
Gender	Male	209	53.6
	Female	181	46.4
Age	<18	108	25.1
	18-25	142	33.8
	26-34	79	19.2
	35-45	70	17.4
	>45	17	4.4
Education	Junior college	167	17.2
	Bachelor	182	64.6
	Master	59	15.1
	Doctor	8	3.1

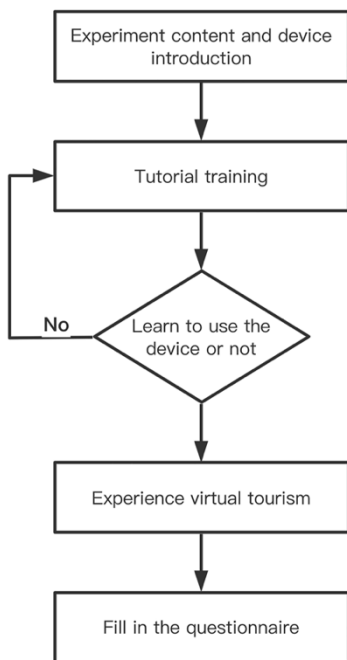
308  
 309 **3.4 Material and Procedure**

310 Quan Jing Wang (<http://www.vra.cn/#/home>) has rich virtual tourism scenic spots resources and contains  
 311 pictures, videos, texts, audio, and other forms. Therefore, we chose the virtual tourism of "VR Panorama of  
 312 the Palace Museum" launched by Quan Jing Wang as the tourists' tour material, as shown in Figure 2. The  
 313 usability testing process was broken down into four main steps, as shown in Figure 3. In the first step, the  
 314 researcher introduced the participants to the content of this usability test and the VR equipment that they  
 315 would need to use to conduct the virtual tourism. In the second step, the researcher showed the participants  
 316 an instructional video on using the VR device for virtual tourism. In the third step, the researcher asked the  
 317 participants if they had learned how to use the VR device for virtual tourism. If the participant answered yes,  
 318 the participant moved on to the next step. If the participant answered no, the participant had to go back to the  
 319 second step and continue learning until the participant learned to move on to the next step. In the fourth step,

320 the participant begins to experience virtual tourism for 40 minutes. In the fifth step, the research team  
321 personnel collected feedback from all participants utilizing a questionnaire and randomly selected  
322 participants for a brief interview. In this way, the participants were urged to complete the test as required until  
323 the end of the test and start filling in the feedback questionnaire.  
324



325  
326 Figure 2. VR Panorama of the Palace Museum  
327



328  
329 Figure 3. Tourist experience process  
330

331 This research focuses on virtual tourists' psychological processes and behavioral intentions. The question  
332 scale content was developed using correlation theories and a conceptual model. The questionnaire includes  
333 two parts: basic information about the subjects and feelings about using virtual tourism. The relevant scales  
334 in this study were all fine-tuned using mature scales or based on mature scales to fit this paper's virtual

335 tourism research context. The stimulus factors were measured using the variables of content quality (three  
336 items), system quality (four items), and interaction quality (three items) adopted from (Aladwani & Palvia,  
337 2002; Babin & Burns, 1998; Chae et al., 2002; Chu & Yuan, 2013; DeLone & McLean, 1992; Kim et al.,  
338 2004; Kuo, 2010; Yang et al., 2005). The organism factors were measured using the variable of tourism  
339 experience (four items) and virtual attachment (five items) adopted from (Jung et al., 2015; Jung et al., 2016;  
340 Mintz et al., 2001; Oh et al., 2016; Pine et al., 1999; van der, 2004; Wang & Yu, 2018; Wu et al., 2019;  
341 Xiaozhou & Zhuanqing, 2015). The response factor was measured using the variable of travel intention (three  
342 items) adopted from (Woodside & Lysonski, 2016).

343 To ensure the accuracy and scientific validity of the questionnaire, the research team first conducted a  
344 small-scale questionnaire pre-test. The test results were also given back to five researchers in virtual tourism,  
345 information behavior, and news communication. The questionnaire questions followed the Delphi method to  
346 adjust, correct, and calibrate the questionnaire repeatedly until the error was controlled within the appropriate  
347 range.

348

### 349 **3.5 Descriptive analysis of demographic characteristics**

350 SPSS 25.0 was used in this study to perform descriptive statistical analysis on the sample data to investigate  
351 the sample's demographic characteristics. According to demographic characteristics, as shown in Table I. A  
352 total of 390 subjects were recruited to participate in the virtual tourism experience in this study, of which  
353 53.6% and 46.4% were male and female, respectively. In terms of age, users aged 18-25 account for the most  
354 significant proportion, 33.8 percent, followed by users younger than 18, accounting for 25.1 percent; in terms  
355 of education, bachelor's education is the mainstay, accounting for 64.6 percent.

356

## 357 **4. Results**

358

### 359 **4.1 Measurement model analysis**

360

#### 361 *4.1.1 Common method variance*

362 The question of common method variance in the sample was first tested for correlation. To prevent the effect  
363 of common method variance on the sample, we hid the names of variables and measurement items in the  
364 questionnaire beforehand and randomly assigned the measurement items in the questionnaire. The Harman  
365 one-way test for common method variance was used. The results of the unrotated factor analysis showed that  
366 there were five factors with characteristic roots greater than one, explaining a total of 75.598% of the variance  
367 variation. The first factor explained 36.722% of the method variance. Therefore, there is no significant  
368 common method bias problem.

369

#### 370 *4.1.2 Measurement model*

371 This study performed structural equation modeling on 390 samples using "PLS-SEM." The SmartPLS 3.3.2  
372 software settings were: "weighting scheme" using "path weighting scheme", "maximum number of  
373 iterations" = 300, and end criterion =  $1 \times 10^{-7}$ . The Bootstrapping test for significance of each indicator:  
374 subsample = 5000, confidence interval method using Bias-Corrected and Accelerated (BCA) Bootstrap, test  
375 type using the two-tailed test, significance level = 0.05.

376 The reliability, convergent validity, and VIF values of the measurement models are shown in Table 2: in  
377 terms of reliability, Cronbach's  $\alpha$  were above the critical value of 0.7 (Fornell & Larcker, 2018), from 0.868  
378 (SQ) to 0.931 (VA); the Composite Reliability is also more significant than the critical value of 0.7 (Hair Jr

379 et al., 2021), from 0.910 (SQ) to 0.948 (VA). Thus, the measurement model has good reliability. In terms of  
 380 validity, the factor loadings ( $\lambda$ ) for all measurement questions were more significant than the critical value of  
 381 0.7 (Hair Jr et al., 2021), from 0.795 (SQ4) to 0.921 (CQ3). In addition, the AVE for all variables were more  
 382 significant than the critical value of 0.5 (Hair Jr et al., 2021), from 0.718 (SQ) to 0.822 (CQ). Thus, the  
 383 measurement model has good convergent validity. In terms of VIF, the Outer VIF Value were all less than  
 384 the standard value of 5 (Hair Jr et al., 2021), from 1.821 (SQ4) to 3.629 (TE3). The Inner VIF Value were  
 385 also less than the standard value of 5, from 1.217 (VA) to 1.531 (SQ), so the structural model did not have  
 386 serious multicollinearity problems. The square root of each variable AVE is greater than the correlation  
 387 coefficient of that variable with any other variable by the discriminant validity test, and the measurement  
 388 model has good discriminant validity, as shown in Table 3.

389

390 Table 2. Reliability and convergent validity analysis (N = 390).

Construct	Items	Factor Loading	Cronbach's $\alpha$	CR	AVE	Outer VIF Value	Inner VIF Value
Content quality (CQ)	CQ1	0.917	0.892	0.933	0.822	2.856	1.321
	CQ2	0.882				2.338	
	CQ3	0.921				2.893	
System quality (SQ)	SQ1	0.850	0.868	0.910	0.718	2.291	1.531
	SQ2	0.840				2.129	
	SQ3	0.901				2.849	
	SQ4	0.795				1.821	
Interaction quality (IQ)	IQ1	0.899	0.870	0.920	0.794	2.384	
	IQ2	0.881				2.180	
	IQ3	0.894				2.364	
Tourism experience (TE)	TE1	0.870	0.918	0.942	0.804	2.475	1.262
	TE2	0.880				2.760	
	TE3	0.919				3.629	
	TE4	0.916				3.540	
Virtual attachment	VA1	0.906	0.931	0.948	0.784	3.495	1.217

(VA)							
	VA2	0.869				2.765	
	VA3	0.879				2.920	
	VA4	0.874				2.836	
	VA5	0.900				3.521	
Travel intention							
(TI)	TI1	0.912	0.883	0.928	0.810	2.766	/
	TI2	0.889				2.239	
	TI3	0.899				2.595	

391

392 Table 3. Discriminant validity analysis (N = 390).

	CQ	IQ	SQ	TE	TI	VA
CQ	<b>0.907</b>					
IQ	0.346	<b>0.891</b>				
SQ	0.409	0.458	<b>0.847</b>			
TE	0.306	0.303	0.410	<b>0.896</b>		
TI	0.326	0.352	0.493	0.678	<b>0.900</b>	
VA	0.310	0.345	0.303	0.102	0.351	<b>0.885</b>

393 **Note:** The diagonal elements (in bold) are the square root of variance shared between the AVEs, whereas the  
394 off-diagonal elements are correlations among constructs.

395

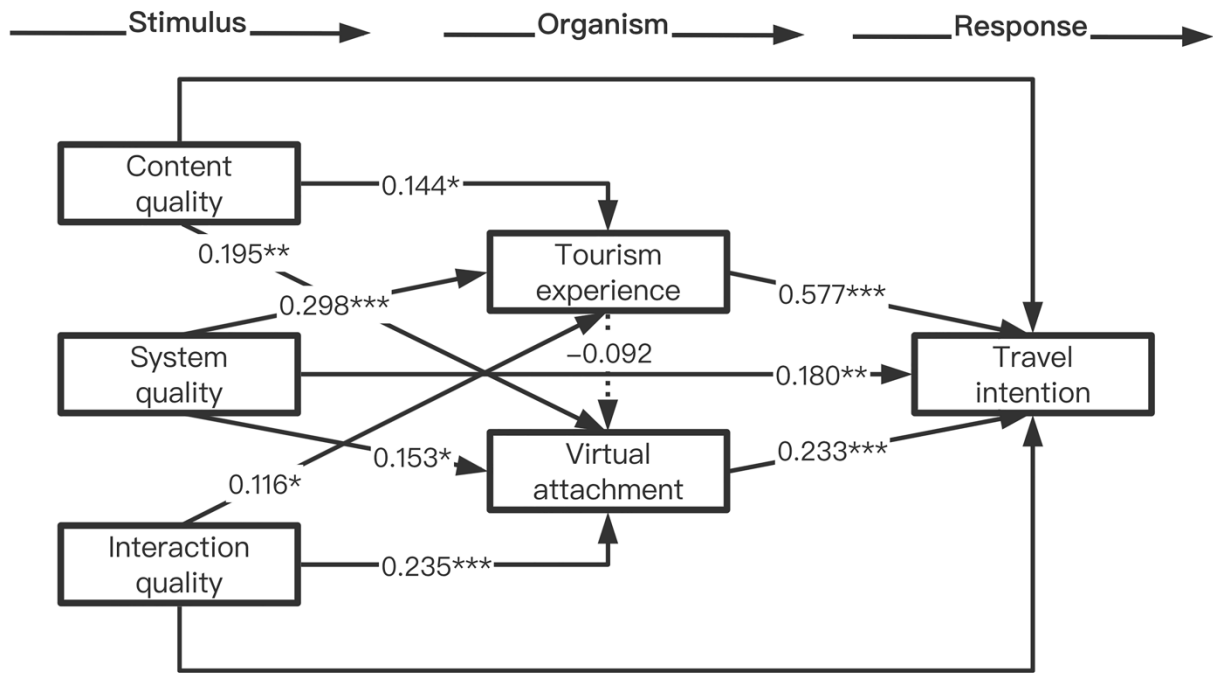
## 396 4.2 Structural model analysis

397

### 398 4.2.1 Path analysis

399 In terms of path analysis, as shown in Table 4 and Figure 4, CQ had a significant positive effect on TE with  
400 a path coefficient of 0.144 ( $p < 0.05$ ); SQ had a significant positive effect on TE with a path coefficient of  
401 0.298 ( $p < 0.001$ ); IQ had a significant positive effect on TE with a path coefficient of 0.116 ( $p < 0.05$ ); CQ had  
402 a significant positive effect on VA with a path coefficient of 0.195 ( $p < 0.05$ ); SQ has a significant positive  
403 effect on VA with a path coefficient of 0.153 ( $p < 0.05$ ); IQ has a significant positive effect on VA with a path  
404 coefficient of 0.235 ( $p < 0.001$ ); TE has a significant positive effect on TI with a path coefficient of 0.577  
405 ( $p < 0.001$ ); VA has a significant positive effect on TI with a path coefficient of 0.577 ( $p < 0.001$ ); SQ has a  
406 significant positive effect on TI with a path coefficient of 0.180 ( $p < 0.01$ ). Therefore, H1-H8 were established.  
407 On the other hand, there is no significant effect of TE on VA; there is no significant effect of CQ and IQ on  
408 TI. Therefore, H9 was not valid. Meanwhile, when performing model fitting and hypothesis testing, the  
409 researchers found that system quality also had a positive effect on travel intention to some extent. So, this  
410 study added hypothesis H16: System quality positively affects travel intention.

411



412

413 Figure 4. PLS results of the structural model.

414 Note: The dotted line indicates that the relationship is not valid.

415 \*\*\*p < 0.001; \*\*p < 0.01; \*p < 0.05.

416

417 Table 4 Path coefficients and research hypothesis testing results.

	Path coefficients	Mean	T-value	P-value	Hypothesis testing results
CQ → TE	0.144	0.143	2.493	0.013	H1 Establish
SQ → TE	0.298	0.299	5.053	0.000	H2 Establish
IQ → TE	0.116	0.117	2.164	0.031	H3 Establish
CQ → VA	0.195	0.194	3.477	0.001	H4 Establish
SQ → VA	0.153	0.153	2.524	0.012	H5 Establish
IQ → VA	0.235	0.235	4.193	0.000	H6 Establish
TE → TI	0.577	0.579	10.737	0.000	H7 Establish
VA → TI	0.233	0.231	4.339	0.000	H8 Establish
TE → VA	-0.092	-0.092	1.850	0.064	H9 Not valid
CQ → TI	-0.002	-0.002	0.041	0.967	/
SQ → TI	0.180	0.180	3.285	0.001	H16 Establish
IQ → TI	0.015	0.015	0.345	0.730	/

418 \*\*\*p < 0.001; \*\*p < 0.01; \*p < 0.05.

419

#### 420 4.2.3 Mediating effect analysis

421 For the mediating effects, TE and VA acted as mediating variables in the relationship between the effects of  
 422 CQ on TI, with indirect effects of 0.083 (p<0.05) and 0.045 (p<0.01) and total effects of 0.081 (p<0.001) and  
 423 0.043 (p<0.001), respectively; TE and VA acted as mediating variables in the relationship between the effects  
 424 of SQ on TI, with indirect effects of 0.172 (p<0.001) and 0.036 (p<0.05) and total effects of 0.352 (p<0.001)  
 425 and 0.216 (p<0.05), respectively. indirect effects of 0.172 (p<0.001) and 0.036 (p<0.05), respectively, and  
 426 total effects of 0.352 (p<0.001) and 0.216 (p<0.001), respectively; TE and VA acted as mediating variables  
 427 in the relationship between the effects of IQ on TI, with indirect effects of 0.067 (p<0.05) and 0.055 (p<0.01),

428 with total effects of 0.082 ( $p < 0.001$ ) and 0.070 ( $p < 0.001$ ), respectively. Since all the above indirect effects  
 429 were positive, the mediating effects were all Complementary mediation (Hair Jr et al., 2021), and H10-H15  
 430 were established, as shown in Table 5.

431

432 Table 5. Mediating effect

	Indirect effect value	Indirect effect P-value	Direct effect value	Direct effect P-value	Total effect value	Total effect P-value	Hypothesis testing results
CQ→TE→TI	0.083	0.014	-0.002	0.967	0.081	0.000	H10 Establish
CQ→VA→TI	0.045	0.006	-0.002	0.967	0.043	0.000	H11 Establish
SQ→TE→TI	0.172	0.000	0.180	0.001	0.352	0.000	H12 Establish
SQ→VA→TI	0.036	0.025	0.180	0.001	0.216	0.000	H13 Establish
IQ→TE→TI	0.067	0.027	0.015	0.730	0.082	0.000	H14 Establish
IQ→VA→TI	0.055	0.006	0.015	0.730	0.070	0.000	H15 Establish

433

434 *4.2.4 Predictive power assessment*

435 The predictive power assessment showed  $R^2=0.201$  for TE,  $R^2=0.566$  for TI, and  $R^2=0.178$  for VA.  $Q^2$  was  
 436 calculated based on Blindfolding, and  $Q^2 > 0$  indicates that the structural model has predictive relevance for  
 437 the endogenous variables and vice versa (Hair Jr et al., 2021). The calculated  $Q^2=0.158$  for TE,  $Q^2=0.450$  for  
 438 TI, and  $Q^2=0.135$  for VA, all of which are greater than 0. This indicates that the structural model has predictive  
 439 relevance for TE, TI, and VA.

440

441 **5. Discussion and conclusions**

442

443 **5.1 Key findings**

444 This study adopts a psychologically derived SOR theoretical framework to explore the impact of virtual  
 445 tourism on tourists' travel intention in the field. The findings and implications are described below.

446 RQ1 was clearly answered (Does virtual tourism experience increase users' travel intention in the field?) .

447 This research revealed a significant positive relationship between content quality, system quality, and  
 448 interaction quality of virtual tourism on tourists' tourism experience, virtual attachment, and travel intention  
 449 through model testing and mediating effect testing, which is consistent with previous studies (Ghose & Huang,  
 450 2009). During home quarantine, the recurrence of the pandemic and the disclosure of various negative  
 451 information led to a surge in stress and anxiety (Xi & Junyi, 2020). Many people were compelled to cancel  
 452 their travel plans. With the intrinsic motivation to travel (Crompton, 1979) and negative information about  
 453 the pandemic, people's psychological need to escape and be free from bondage is triggered to a certain extent.  
 454 The magnificent scenery of virtual tourism attractions provides people with the opportunity to shortly escape  
 455 from reality. It brings a visual feast of beauty, facilitating the creation of virtual attachment. In addition, the  
 456 quality of content, system quality, and interaction of virtual tourism (Deng et al., 2019) enable tourists to  
 457 obscure the boundaries between the virtual and physical realities (Biocca, 1992; Deng et al., 2019), which  
 458 generates a higher degree of authenticity in the tourism experience (Kim et al., 2018). In the virtual  
 459 environment created by virtual tourism, tourists develop virtual attachments and experience unique tourism  
 460 experiences distinct from natural tourism. These factors ultimately impact tourists' travel intention in the field.  
 461 As a new type of tourism, virtual tourism has novel and unique characteristics that attract tourists and inspire  
 462 their curiosity. As a result, virtual tourism strengthens tourists' intention to run to the destinations promoted

463 in virtual tourism by providing immersive tourism experiences and realistic virtual attachments.

464 The following findings can be reported for RQ2 (What factors change tourists' travel intention in the field  
465 of virtual tourism?). Tourism experience and virtual attachment are critical variables which influence tourists'  
466 travel intention in the field and relates to in whether virtual tourism can attract more tourists. This empirical  
467 analysis revealed that tourism experience and virtual attachment positively impact tourists' travel intention  
468 in the field. Tourism experience has the most significant impact on travel intention in the field, followed by  
469 virtual attachment, which is mainly relevant to the form and nature of virtual tourism. As a new form, the  
470 ultimate goal of virtual tourism is to provide tourists with an ideal tourism experience. Thus, virtual tourism  
471 will be designed to consider tourists' needs to meet the tourism experience, enabling tourists to gain desired  
472 virtual experience. Thus, the tourism experience has the most significant impact on the travel intention in the  
473 field. In addition, tourists may develop emotional attachment to the actual tourist place through the interaction  
474 between the virtual space and the 3D reconstructed scenery, creating an emotional connection with the place  
475 they have not visited, which further influences the travel intention in the field.

476 The following findings can be reported for RQ3 (How do influencing factors of virtual tourism experience  
477 <content quality, system quality, interaction quality>, tourism experience, virtual attachment, and travel  
478 intention interact with each other?). System quality may directly and significantly affect travel intention  
479 positively. Tourism experience and virtual attachment play a complementary mediating role in influencing  
480 relationships of content quality, system quality, and interaction quality. As shown by the relative effect values  
481 of the mediating effects, the indirect effects are significant in proportion. Tourists' knowledge of the scenery  
482 presented in virtual tourism drives their travel intention while granting them real tourism experience and  
483 virtual attachment during the tour, further motivating travel intention. In addition, there was no significant  
484 positive impact of tourism experience on virtual attachment. The results of this study contradict the findings  
485 of Guest & Lee (2016) and St. John et al. (1986). The emergence of virtual attachment requires a deeper  
486 connection between the tourist and the destination. The positive perceptions and memorability developed  
487 from limited tourism experiences do not allow for emotional connection or psychological identification with  
488 the virtual destination. Thus, tourism experiences and virtual attachment do not have a direct correlation.

489

## 490 **5.2 Theoretical implications**

491 This study's theoretical contributions are categorized into three parts.

492 First, we studied the three contributing dimensions of virtual tourism experience and travel motivation  
493 under the immersive "S-O-R" research design. Namely, content quality, system quality, and interaction  
494 quality (Gorla et al., 2010; Korfiatis et al., 2012; Pelau et al., 2021). Further, we expanded their meaning  
495 under the scope of VR tourism. Content quality refers to the intrinsic values, i.e., objectivity, credibility, and  
496 the amount of information the virtual tourism provides. System quality refers to the quality of the tourist's  
497 use of virtual tourism and its design in terms of structure, presentation, and connectivity. Interaction quality  
498 is the ability of virtual tourism to provide interactive features to tourists. With these delimitations, this study  
499 constructs a relational model which suggests a positive relationship between those qualities and tourism  
500 intention through the mediation of virtual content characteristics. Together, the results should be carefully  
501 considered in building virtual tourism interactions, providing information to tourists, and understanding  
502 tourists' preferences.

503 Second, prior Studies have conducted empirical tourism research for VR only in a limited number of areas.  
504 First, web-based visual images, such as 360°panoramic images (Caciora et al., 2021; Hu et al., 2020; Lu et  
505 al., 2021). Second, virtual environments are based on fictional worlds in VR games (Coghlan & Carter, 2020;  
506 Gao et al., 2022). Third, virtual environments are displayed on a two-dimensional computer screen (Chiquet



507 et al., 2020; Tian & Tsai, 2021). In addition, few tourism studies have used VR devices to conduct usability  
508 tests on live-action virtual tourism products. By focusing on the sensory stimuli evoked by VR technology,  
509 our work examines the psychological processes of tourists' travel experiences and reactions to virtual tourism  
510 products. Since VR technology is constantly evolving, this study will be a good reference paradigm for future  
511 usability studies of virtual tourism products based on VR technology.

512 Third, scholars' prior studies on travel intention have focused on influencing factors of travel intention  
513 (Shin et al., 2022; Wang et al., 2022), relationship studies (Moon & Han, 2018a; Piramanayagam et al., 2020),  
514 and place attachment (Lalicic & Garaus, 2020; Tasci et al., 2021). Researchers' work on travel intention was  
515 first extended from social behavior, where it was generally accepted that "travelling" is also a social behavior.  
516 The research methods used by scholars for research in this area are mainly quantitative methods, such as  
517 factor analysis and constructive modeling. In terms of research content, scholars have expanded from the  
518 factors influencing its formation to the study of relationships. Later scholars have focused more on the  
519 emotional expression of individual tourists and explored the relationship between tourism intention and place  
520 attachment. This study builds on the prior studies and further explores a research model more consistent with  
521 Chinese tourists' travel intention to virtual tourism destinations in the post-COVID-19 era.

522 Finally, this study identified virtual attachment as an antecedent factor influencing tourists' travel intention  
523 in the field, which is rarely seen in virtual tourism research. The study revealed that virtual attachment is a  
524 prominent variable influencing tourists' travel intention in the field. Virtual attachment differs from other  
525 variables as it incorporates more of the tourists' affective experiences. In such a new way of tourism, tourists'  
526 emotions are evident in their subsequent behavior and they develop emotional attachments to real travel  
527 destinations through interactions with three-dimensional reconstructions of scenic areas in virtual space,  
528 creating emotional connections to places they have not visited and further influencing their travel intention  
529 to the field. The findings empirically develop the ternary space theory of tourist places, i.e., the traditional  
530 two-dimensional perspective of the tourist-place relationship is extended to a three-dimensional ternary space,  
531 further illustrating the interrelated, interactive, and dynamic response characteristics of the ternary area (Chen  
532 & Zhenfang, 2020). Since the individual variability of tourist groups, the influence of virtual attachment on  
533 tourists' travel intention in the field cannot be neglected.

534

### 535 **5.3 Practical implications**

536 First, this study discovered that tourism experience positively impacts travel intention ( $p=0.001$ ). The path  
537 coefficient of the variable of the tourism experience is 0.577, which is greater than other variables. This  
538 indicates the magnitude of tourists' perceptions of their experiences during virtual tours on their subsequent  
539 travel intentions in the field. Virtual tourism changes the way tourists visit a scenic area by providing them  
540 with more opportunities to interact, contextualize, and share with others. This study finds that content quality,  
541 system quality, and interaction quality can affect tourists' tour experience. Hence three perspectives of content,  
542 system, and interaction can be adopted to enhance their experience.

543 From a system perspective, the system quality of virtual tourism impacts the tourist experience, virtual  
544 attachment, and travel intention. Hence, the design of the presentation form as the carrier of the system quality  
545 is essential. The current way of virtual tourism, in addition to traditional AR, VR, as a powerful means of  
546 augmented reality - holographic projection technology also has a vast space for development. This technology  
547 is not unattainable, and holographic projection technology has been used in many scenarios, such as virtual  
548 idol concerts. However, holographic projection technology has rarely been used in the tourism industry.  
549 Future virtual tourism technology researchers can make this technology universal so that tourists' homes  
550 become distant scenic spots.

551 From an interactivity perspective, the interactivity quality affects tourists' tourism experience and virtual  
552 attachment, which affects their travel intention. Currently, virtual tourism has a lot of room for development  
553 in the interactivity aspect. Granted, the rise of the Internet has brought a completely different experience to  
554 virtual tourism interactivity than in the past. Tourists can communicate and interact through real-time voice  
555 and other means. When tourists travel in the field, on the one hand, they can interact with people; on the other  
556 hand, the interaction between people and scenery, people and things are also essential for tourists when  
557 traveling in the field. Photographing is usually one of how people interact with the scenery. Developers of  
558 virtual tourism can use cinematic stunts to allow users to pose for photos with scenes in virtual scenes.  
559 Techniques such as AR photography and Photoshop (PS) can also increase tourists' engagement. In terms of  
560 human-object interaction, virtual tourism does not allow tourists to taste the specialties of the tourist  
561 destination as much as onsite tourism. Therefore, virtual tourism developers can incorporate the function of  
562 take-out recommendation during the virtual tourism scenario setting. Tourists can order a local specialty dish  
563 at home, such as Hangzhou dish, during virtual tourism in Hangzhou. In addition, developers can also add  
564 restaurant recommendations. For example, the system can recommend local Sichuan cuisine restaurants in  
565 Sichuan virtual tourism. Users can go straight to the restaurants in the tourist destination after virtual tourism  
566 to satisfy the tourists' desire for food, which is one of the most effective ways to increase tourists' travel  
567 intention in the field. Finally, future virtual tourism developers can optimize virtual tourism from other  
568 perspectives, such as growing tourists' olfactory or tactile experience.

569 From a content perspective, content quality affects tourists' tourism experience and virtual attachment,  
570 affecting their travel intention. At the beginning of the pandemic, virtual tourism took up a large amount of  
571 demand for outbound travel. While domestic travel in China has thawed after the pandemic has been  
572 alleviated, outbound travel remains ice-bound. Content quality has become almost the only growth area in  
573 the post-pandemic era that can increase tourists' travel intentions onsite. The quality of content for virtual  
574 tourism requires inspiring tourists and providing practical travel information, and generating real value for  
575 tourist attractions and local government departments for tourism. The pandemic has further deepened the  
576 importance of tourism content quality. From the perspective of tourists' needs, in the post-pandemic era, faced  
577 with new information gaps, tourists increasingly need tourism information related to COVID-19  
578 precautionary measures, such as the need for Polymerase Chain Reaction (PCR) test reports and unique  
579 business hours schedules for attractions. This information needs to be updated by virtual tourism operators  
580 in the first instance in the virtual tourism scenario. Virtual tourism need to provide tourists with the fastest  
581 and most accurate information related to the pandemic.

582 Finally, virtual attachment directly and positively affects the travel intention, highlighting the importance  
583 of constructing a person-place emotional identity in virtual tourism (Kim et al., 2018). When tourists develop  
584 heartfelt and emotional attachments (e.g., desire for spiritual purification and pilgrimage experiences (Chang  
585 et al., 2020)) to tourist places during virtual tours, and these needs are challenging to satisfy through the  
586 mirroring experience of virtual tourism, travel intention in the field are significantly enhanced in the future.  
587 In this regard, the virtual tourism design process should focus on the realistic simulation of beautiful scenery  
588 and stimulating tourists' spiritual resonance and emotional identification with the tourist destination, thus  
589 enhancing the effectiveness of virtual tourism as a marketing method. In addition, virtual tourism must not  
590 develop independently due to the inseparable relationship between online and offline. Specifically, virtual  
591 tourism will not wholly replace offline tourism because offline tourism is the root of virtual tourism. Without  
592 the development of offline tourism, virtual tourism will also lose the creative material. Although virtual  
593 tourism is not the pure auxiliary tool it used to be, an essential role of virtual tourism in the post-pandemic  
594 era is still to provide a reference for people to travel offline. After all, there is no substitute for offline travel

595 that brings tourists a natural feeling.

596

#### 597 **5.4 Limitations and future research**

598 There are some shortcomings in this research on the effect of virtual tourism on tourists' travel intention.  
599 First, the quantitative dimensions of virtual tourism can be further enriched and deepened. The quality of  
600 virtual tourism in this study was manifested in three aspects: interactivity quality, content quality, and system  
601 quality. With the development of technology however, new quantitative dimensions of virtual tourism display  
602 are bound to emerge, so future research may explore new quantitative dimensions of virtual tourism through  
603 methods such as grounded theory and big data mining. Second, since the data collection of this study was  
604 completed during the pandemic, the virtual attachment of virtual tourists may be affected by the pandemic  
605 itself. When there is a risk of infection during the trip, tourists in a housebound state may generate higher  
606 attachment levels than during the unusual period. In other words, attachment to virtual tourism experience  
607 may be weakened when tourists are free to physically travel and experience destinations. Thus, the  
608 transformational relationship between tourists' virtual attachment and travel intention in the field when going  
609 out is unrestricted and can be further investigated in the future. Third, the data collected in this study came  
610 from virtual tourists in China. The underlying collectivism and high-power distance, as well as the relational  
611 culture characteristics of China (Zhao et al., 2008) may also impact interpersonal relationships and social  
612 interactions, which may be very different from the perceptions of virtual tourism by tourists in other countries  
613 and cultures. Therefore, regarding the impact of cultural differences, cross-cultural comparisons could be  
614 enhanced in future research endeavors to understand the effects and impact mechanisms of virtual tourism  
615 on tourists from different cultural backgrounds.

616

#### 617 **Conflict of interest statement**

618 On behalf of all authors, the corresponding author states that there is no conflict of interest.

619

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